

Hypothesis Testing about a Population Mean (When standard deviation is NOT known).

First, Let's remember a few key concepts, variables, requirements, and formulas:

- 1.) What is the purpose or goal of conducting a hypothesis test?
- 2.) What is the difference between the Null hypothesis and the Alternative hypothesis?
- 3.) What does it mean to "Reject" the Null hypothesis?
- 4.) What does it mean when we "Fail to Reject" the Null hypothesis?
- 5.) Why do we use the phrase "Fail to Reject" instead of "Accept"?
- 6.) What does a critical region represent?

7.) What do each of these variables represent?

$\mu =$

$\sigma(\text{unknown}) =$

$\bar{x} =$

$s =$

$n =$

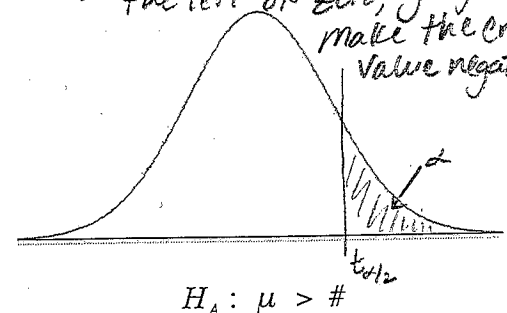
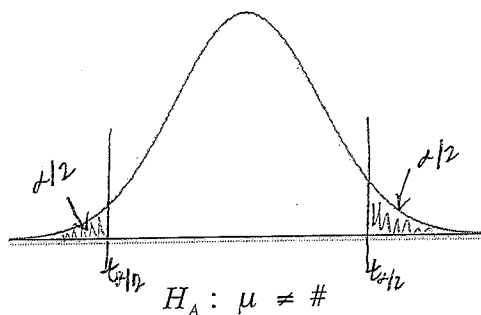
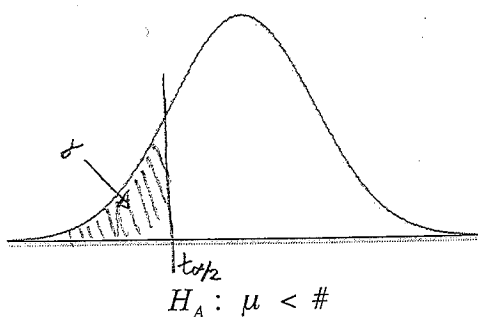
degrees of freedom = $n - 1$

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}}$$

$t_{\alpha/2}$ can be found using Table A-3 (page 774)

The Null Hypothesis always refers to equality: $H_0: \mu = \#$

The Alternative Hypothesis tells us where the critical region is located.



Note → All critical t-values in Table A-3 are positive. If you are finding a value to the left of zero, you just make the critical value negative.

An Example using the TRADITIONAL METHOD.

Problem: A major car manufacturer wants to test a new engine to determine whether it meets new air-pollution standards. The mean emission for all engines of this type must be less than 20 parts per million of carbon. (That was the claim) Ten engines are manufactured for testing purposes, and the emission level for each is determined. The mean and standard deviation for the tests are 17.17 and 2.98 parts per million of carbon. Does the data supply enough evidence at a significance level of 0.01 to allow the manufacturer to conclude that this type of engine meets the pollution standard?

First find all of your values:

$$n = 10 \quad df = n - 1 = 9 \quad \bar{x} = 17.17 \quad s = 2.98 \quad \mu = 20 \quad \leftarrow \text{claim}$$

Step #1: Write out the Hypotheses:

$$H_0: \mu = 20$$

$$H_A: \mu < 20$$

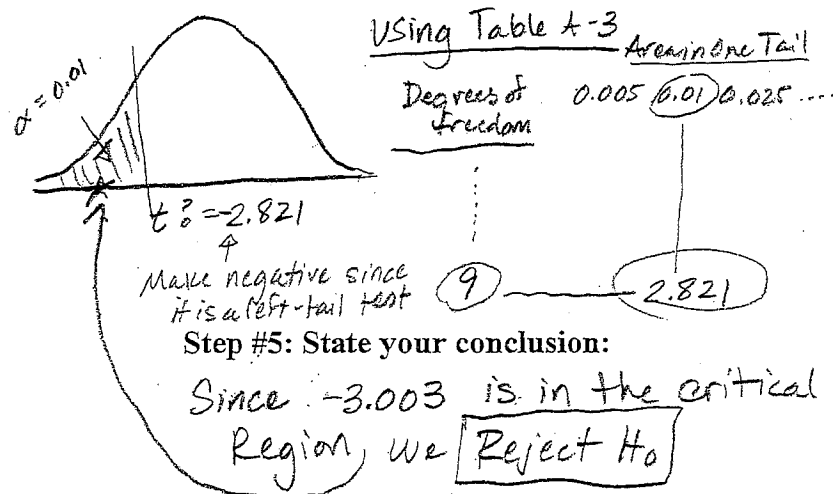
Step #2: What is the significance level?

$$\alpha = 0.01$$

Step #3: Find the critical value:

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{17.17 - 20}{\frac{2.98}{\sqrt{10}}} = -3.003$$

Step #4: Find the critical region:



Example #2: What if the claim had been that "the mean emission for all engines of this type must be EQUAL to 20 parts per million of carbon"? Test this claim with a significance level of 0.01.

Step #1: Write out the Hypotheses:

$$H_0: \mu = 20$$

$$H_A: \mu \neq 20$$

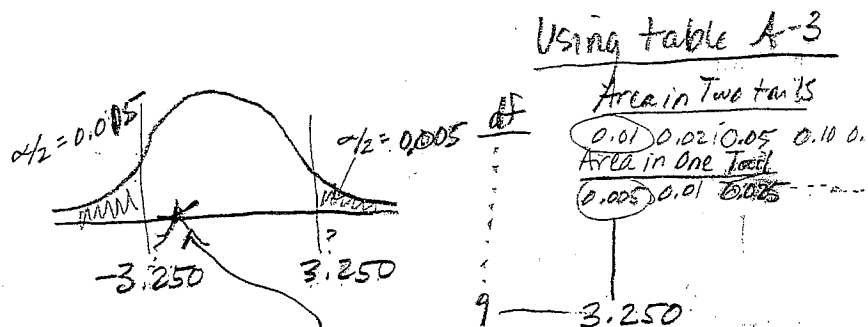
Step #2: What is the significance level?

$$\alpha = 0.01$$

Step #3: Find the critical value:

$$t = \frac{\bar{x} - \mu}{\frac{s}{\sqrt{n}}} = \frac{17.17 - 20}{\frac{2.98}{\sqrt{10}}} = -3.003$$

Step #4: Find the critical region:



Step #5: State your conclusion:

Since -3.003 is not in the critical Region, we **Fail to Reject H_0**